Distance Learning as a Tool for Poverty Reduction and Economic Development: A Focus on China and Mexico

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This paper uses case studies to focus on distance learning in developing countries as an enabler for economic development and poverty reduction. To provide perspective, we first review the history of telecottages, local technology-equipped facilities to foster community-based learning, which have evolved into "telecenters" or "Community Learning Centers" (CLCs). Second, we describe extensive site visits to CLCs in impoverished portions of China and Mexico, the centers operated by premier universities in each respective country. These CLCs constitute the core of new emerging systems of distance education, and their newness poses challenges and opportunities, which are discussed. Finally, we offer 12 points to develop further the concept and reality of distance learning in support of economic development.

KEY WORDS: distance learning; economic development; poverty reduction; China; Mexico

Early in 2003, the Director of Community Learning Centers (CLCs) in Mexico, Ms. Laura Ruiz, hosted visitors at the Virtual University of the Tecnologico de Monterrey. Knowing their interest in learning more about the CLC's, she brought them to visit an actual learning center. Ms. Ruiz and her guests were surprised to see a 10-year-old girl sitting at a computer. Ms. Ruiz asked what she was doing there, and the girl replied, "I have taken the Basic Computer Abilities Course, and now I am taking the Labor Certification Process." Hearing this, Ms Ruiz was amazed to see that this little girl had finished a course not designed for children. She worried that since this girl was only 10 years old, she might not get the certificate. As soon as Ms. Ruiz got back to Monterrey, she called to investigate the issue. They told her that they never thought a child would finish the course, but that they did not have a rule saying that a child could not get the certificate. So for the first time, they awarded the certificate to a 10-year-old girl!

This one little story tells so much about how distance learning provided to poor, underserved communities can dramatically change the lives of people who live there, people old and young, sometimes quite young! With distance learning, what a person can learn is no longer dependent on where she was born or where she lives today. Quality education is now possible anywhere at any time. This means hope for those in underserved communities, as they can learn the same material as their fellow countrymen in more affluent communities, thereby giving them an economic and social upward mobility never before possible.

In this paper, we focus on two programs aimed at reducing poverty and accelerating economic development in two countries—China and Mexico, both programs leveraging modern Information and Communication Technologies (ICT's) to deliver quality education to underserved communities. The programs are new and growing and thus still in formative stages. We describe these programs and offer a framework for continuous assessment and

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evaluation. This can facilitate ongoing self-improvement, so the programs can utilize continuing data and qualitative experience as a self-learning, self-improving organization. Each program is unique in its detailed implementation, but each has very similar goals—reducing poverty and improving economic development by educating local citizens, young, old and in-between.

First, we describe the history of CLCs, as they were first implemented in Scandinavia and then throughout much of the developing world. Second, we describe in detail the China and Mexico university-affiliated networked systems using CLCs. Third, building from our personal visits to Chinese and Mexican facilities, we offer a point-by-point framework for assessment and evaluation.

The case studies presented herein are part of a larger volunteer effort at MIT called LINC, Learning International Networks Consortium, as described elsewhere in this issue (Park and Zellweger, 2006). In their paper, Park and Zellweger present numerous references that place LINC and its programs in context of our collective knowledge of distance learning and its application to economic development.

HISTORY OF COMMUNITY-BASED DISTANCE LEARNING

> To learn without thinking is fruitless;
> To think without learning is dangerous.
> Confucius

The use of ICT's to alleviate poverty in rural parts of the world is a widespread yet largely unevaluated development initiative. For this reason, we devote some effort towards providing a broader historical and international context for the issues surrounding the use of technology to bring education to underserved areas.

According to Royal Colle of Cornell University, the idea of bringing computer technology to poor and isolated rural areas first emerged in the 1980s in Scandinavia with the concept of "telecottages" (Colle and Roman, 2001). At that time, even before the founding of the Internet, the purpose of these telecottages was "to fight against the marginalization of people in remote areas when it came to ICT's and the Information Society." During the mid-1990s, the idea of telecottages was expanded in Hungary with a new goal of achieving social and economic development through the use of computers and the Internet. By the end of the 20th century, this concept of community-shared computer centers to foster social development and alleviate poverty had begun to spread around the world. Although these "telecenters," as they are widely known, come in many different forms, the two key elements are public access and a focus on development. It is this second characteristic, the tie to development, that distinguishes these centers from commercial cyber cafés.

At this point it might be useful to ask, "Just what is the role of ICT's in reducing poverty?" Some people believe that computer technology is the panacea for poverty reduction, while others view it only as a distraction and financial drain from the real issue of meeting the basic human needs of poor people. Most experts believe that the answer to this important question lies somewhere in between. While public computer centers cannot alleviate poverty on their own, they certainly can support and strengthen national and international efforts to promote social and economic development. In this regard, research and experience have shown that the application of ICT's for poverty alleviation should always begin with a clear development strategy: in what measurable ways will the services of this computer center positively impact residents of this community? In addition, it is critical to have bottom-up, demand-driven development objectives rather than those directed from the top; this insures that the needs of development recipients are taken into consideration from the very first stage of planning. The goal is not to fill a room with computers, but rather to improve the every day lives of local poor people.

We review several of the "telecenter" ventures that are currently underway in various parts of the world. One example is that of the "Village Information Centers" in Pondicherry, India, consisting of 10 villages connected within a wired and wireless network of telecenters and equipped with PC's, telephones, VHS duplex radio devices, and e-mail connectivity. Citizens report that the centers have brought benefits to them in the following areas: employment opportunities; entrepreneurial development; health, education, and fishing support; and government entitlements (Colle, 2005). The success stems from initial close planning with the 10 communities. Each village had a voice in determining exactly what information content would be available at its center.

Peru has begun an ambitious plan to transform many of its commercial computer kiosks into "telecenters" for the alleviation of extreme poverty in rural areas. By early 2006, Peru reportedly had opened 30 community computer centers in rural areas, with the goal of establishing 1050 centers within the next 3 years. These Peruvian centers are designed to be social meeting places where villagers can learn how to access a wide range of appropriate information, for example, information on rural technology, weather, crop prices, health issues, distance mel functions opportunities, government services, etc.

In Brazil's urban slums, the Committee to Democratize Information Technologies (CDI) has set up more than 200 sustainable and self-managed Computer Science and Citizenship Schools (Baggio, 2005). The goal of the CDI program is to equip economically disadvantaged youths with marketable skills, and so far more than 60,000 students have been trained in ICT's. The CDI schools have been so successful that 100 more are currently planned for urban areas in Mexico, Japan, Uruguay, and Colombia.

The Little Intelligent Communities Project (LINCOS) was initiated in Costa Rica in 2001 to help one of the country's poorest regions overcome the problems of rural isolation through introduction of computers and the Internet (Amighetti and Reader, 2003). However, to the surprise of project founders, the target audience of poor, rural residents was not at all interested in the ICT services available to them. Instead, business people, particularly coffee growers, traveled great distances to the LINCOS Center to access these services. The failure of the LINCOS Project to achieve its original objectives stems in part from a failure to include the target population in early planning and a failure to educate them about the value of ICT's in their lives.

Turning to South Africa, the Gaseleka Telecenter has been in operation since 1999 (Telecenters in Africa, 2004). Gaseleka is located in an isolated, rural, and arid region about 80 km. from the nearest town. At the Gaseleka Telecenter, there has been great success with a basic computer course that includes 150 hours of coursework and lasts 15 weeks. The center also has an arrangement with two South African universities to provide distance-learning education to local residents who want it. A similar center in Uganda is the Nakaseke Multipurpose Community Telecenter, which also opened in 1999 (Telecenters in Africa, 2004). In addition to ICT services, the center has paper and digital libraries, computer training classes, and an Indigenous Knowledge program in which the staff are building a digital resource of local health and crop experiences. The Center at Nakaseke aims to serve the entire community, especially the following core user groups: women, youths, children, the medical community, workers, teachers, farmers, and government workers.

Back in India, the Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) created a small network of three rural telecenters in the state of Tamil Nadu (Renganathan, 2004). The project was aimed at assessing the needs of agricultural village communities and answering those needs through the use of Information Technologies. This particular network of public computer centers is unique in one very special way: it was founded by a university and supported by that university's technical and research capabilities. TANUVAS students conducted most of the initial needs assessment, and university faculty and staff designed all of the centers' ICT services, including the web pages that the farmers can access. Unfortunately, this kind of university involvement is something that is lacking in much of the international telecenter movement today.

This brings us back to the main subject—the computer learning center initiatives underway in China and Mexico to alleviate poverty in isolated, rural areas. There are three characteristics of the initiatives taking place in these two countries that distinguish them from other computer center initiatives aimed at social and economic development. The first is a *close involvement of a university* in the design, development, and operation of the programs. In 2003, Tsinghua University launched a project to develop distance learning facilities and educational resources in some of the 592 impoverished counties in the western areas of China. Tsinghua has had the goal of setting up 100 distance learning centers within the next year or so. The project is managed by the Tsinghua School of Continuing Education, and makes full use of the university's educational resources, ICT know-how, and management experience in order to improve the development of poor rural communities. In Mexico, the Virtual University of the Tecnologico de Monterrey ("Monterrey Tec") established that country's initiative of Community Learning Centers (CLCs) in 2002. Currently the program includes approximately 1050 Community Learning Centers in Mexico and 106 in the United States. The Virtual University has invested its 15 years of experience in distance and e-Learning

tertiary education to develop wide-ranging content for the network of CLCs. Furthermore, faculty, staff and students of Monterrey Tec are actively involved in this effort to bring social and economic development to impoverished regions of the country. The recently re-written Mission Statement of Monterrey Tec identifies the transfer of knowledge for sustainable social development as a high priority of the university for the 21st century (Lopez Del Puerto, 2004).

A second characteristic that distinguishes the Chinese and Mexican programs from other initiatives is a primary focus on *using education to strengthen and support development*. In most parts of the world, community computer centers are multi-purpose, and the aim is to encourage development by the introduction of a wide range of ICT services. In contrast, the programs in China and Mexico are clearly designed to provide distance and e-Learning course content that will impact development through education. Both programs have as a priority the delivery of quality education via technology to educators, school administrators and local leaders of isolated rural communities. The strong university connection of these programs provides them with immediate access to a high quality educational content.

The third and final distinguishing characteristic of the Chinese and Mexican initiatives is the fact that these programs involve *a large network* of public computer centers that are linked within a wider educational *system*. In this sense, they are unlike the majority of telecenters cited above. The two programs under discussion here are expansive and ambitious undertakings in which educational content can be created for, distributed to, and shared by a large number of poor, rural citizens.

NEW SYSTEMS IN CHINA AND MEXICO

Much of our knowledge of the Chinese and Mexican distance educational systems is based on trips we took to the respective countries in 2004 and 2005. Our trip to China occurred October 7–22, 2004, where Professor KANG Feiyu and his colleagues at the School of Continuing Education of Tsinghua University generously set up for us a sequence of visits to distance learning centers and technology-equipped schools. These involved visiting two counties in each of the autonomous regions of Inner Mongolia and Ningxia Huixou. During these visits, we were able to meet many teachers and students. At each visit, we held informal discussions, viewed the various technologies used in each setting, and heard formal presentations by leaders of the respective sites.

Our trip to Mexico took place May 2–15, 2005. Ms. Laura Ruiz and her colleagues at the Monterrey Tec generously arranged the trip, during which we visited 13 CLC's throughout the Mexican state of Nuevo Leon. (CLC's in Spanish are called *Centros Comunitarios de Aprendizaje*, abbreviated "CCA.") Also, we spent 2 days at Monterrey Tec visiting with virtually all of the leaders of poverty reduction and community outreach programs offered by the university. In each of the 13 CLCs, we met and interviewed the local facilitator of the center (called "promoter"), spoke with students, observed the technology and its use, and tried to understand the perceived successes and disappointments associated with each center.

The Tsinghua University "Education-Aiding-the Poor Project"

Tsinghua University was the first Chinese university to deliver distance-learning education, having started in 1998. Tsinghua started continuing education as an evening school in Beijing in the 1950s. The establishment of the Tsinghua School of Continuing Education was approved by the Ministry of Education in 1985, and was made a legal entity in 2002 (See http://www.tsinghua.edu.cn/eng/about/CE.htm). Tsinghua has developed an advanced distance-learning delivery platform and accumulated a wealth of resources during its 8 years of experience. The university has built a nationwide distance-learning program by adopting multiple technologies, including the Internet, satellite broadcasting networks, cable TV networks, ISDN and video conferencing (School of Continuing Education of Tsinghua University, 2004).

The aim of the Tsinghua University Education-Aiding-the-Poor Project (EAPP) is to provide people in underdeveloped areas with the opportunity to access high-quality educational resources by means of modern information technology. The goal is to eliminate poverty by spreading knowledge. Program planners have selected 100 state-targeted counties living below the national poverty line, to assist them in establishing distance-learning stations free of charge. EAPP will also set up Internet education resource centers that will provide various groups with educational resources via satellite.

Needs Analysis

As of October 2004, Tsinghua University staff had visited over 60 underdeveloped counties, located in the following provinces: Yunan; Guizhou; Sichuan; Chongqing; Shanxi; Gansu; Guangxi; Inner Mongolia; Ningxia; Xinjiang; Hunan; Hebei; Jiangxi; Anhui; Shaanxi; Henan and Hainan. The assessment, conducted among government officials, primary and middle school students, teachers and farmers, showed that there is an urgent need for high-quality educational resources. The highlights of the assessment are as follows: first, local government officials need training in modern administrative management knowledge and skills. Second, primary and middle school students need information and knowledge from developed areas so that they can improve their own living conditions within their communities. Third, primary and middle school teachers need knowledge of advanced educational concepts and teaching methods in order to help students improve their social and economic positions. Finally, farmers need advanced agricultural skills, market information, and talent necessary in order to increase family income. The assessment identified other educational needs as well, including: pregnancy treatment; more general medical treatments; sanitation; environmental protection; and tourism development and management.

Implementation

The initial project tasks were: (1) to establish the Tsinghua University Education-Aiding-the-Poor Distance-Learning Centers; (2) to create and transmit education resources suitable for the underdeveloped areas; (3) to continue research on Education-Aiding-the-Poor Project. The implementation process entailed the following steps:

- Select a local educational training organization that meets the necessary criteria from among the state-targeted counties selected by Tsinghua.
- Provide free of charge satellite receivers and data management systems for these centers named "Tsinghua University Education-Aiding-the-Poor" Distance-learning Centers.
- Provide training on the techniques of receiving, producing, and using distance/e-Learning education resources for administrators of the centers.
- Assist them in recruiting potential candidates to attend suitable trainings.
- Transmit the education received by centers to villages and towns, utilizing the existing transmission networks.

After careful investigations, project planners selected 49 state-targeted counties and assisted them in setting up distance-learning stations. Tsinghua then delivered the following training courses by satellite broadcasting and CD to government officials, primary and middle school students and teachers, and administrators from town enterprises:

- Leadership skills improvement courses;
- Enterprise management courses;
- Judicial officials training courses;
- Education administration and management courses;
- English and computer training for village and township officials and teachers;
- Applied agriculture technology.

About 10,000 people have attended these trainings through October 2004, the time of our visit.

Due to the newness of the program and the fact that it is not yet even fully implemented, there has not been a full impartial outside evaluation or assessment of the program. This may be called for in 2 or 3 years, after full implementation, resolution of major stumbling blocks and graduation of tens of thousands of life-long learning students.

The Tecnologico de Monterrey's Social Development Program

The Virtual University of the Monterrey Tec began in 1989 with a founding vision to use modern technology to extend quality higher education throughout Mexico. It currently has 80,000 students, including students in formal degree programs, continuing education programs, and social development programs. In formal degree programs, there are 6000 at the undergraduate level and almost 6000 at the Master's level. The Virtual University also reaches out to students from the entire Latin American community in the Western Hemisphere.

The Monterrey Tec's Virtual University has become a leader in developing the new Student-Centered Collaborative Learning model for online education. In this learning model, the student is at the center, and the educational process involves a path of self-guided learning. The faculty member is a kind of coach or guide who is there to help students acquire the knowledge they require from various available sources. This learning model relies heavily on tutors to maintain communication with virtual students, answering questions and encouraging collaborative learning among geographically dispersed students. Research has shown that, with this learning model, the online students are more interested, more

proactive, and achieve a better result in terms of the actual knowledge they receive.

The Virtual University began using satellite transmission of educational content as a means of achieving greater social inclusion throughout Mexico. The objective was to utilize Monterrey Tec's multi-campus system as locations for widely dispersed satellite reception centers covering most of the country. With the arrival of the Internet during the 1990s, Monterrey Tec started working with online education through satellite transmission, reaching areas whose infrastructure made it possible. However, for the very marginalized areas, a lack of such infrastructure became a daunting problem. Eventually, to overcome this challenging situation, Monterrey Tec decided to establish remote, learning centers in previously marginalized and underserved areas of the country. In this way, every computer connected to the satellite Internet could become a classroom, and the Social Development programs described below began to develop.

In the late 1990s, the Monterrey Tec developed a strategy, through its Virtual University, to close the gap between the most privileged and the least privileged people in Mexico. This initiative, called the Social Development Program, is partnered with the public, private and social sectors, and is designed to make social and economic impacts through several complementary programs described below.

National Education and Development Programs

This initiative is built on the premise that every educational system is made up not only of teachers, but also of managers, parents, and students. The programmatic goal is to use the Internet to have a separate offering for each of these educational partners—teachers, managers, parents, and students—so that at the end of 2 or 3 years, Monterrey Tec can make a significant impact upon the entire system. In addition to offering this program in Mexico, Monterrey Tec also brings lessons learned in Mexico to other developing countries. For example, in 2004, Monterrey Tec received an $8 million contract from El Salvador to conduct training in the Kindergarten-to-grade 12 schools there.

Offerings for teachers are numerous, including Bachelors, Masters and continuing education programs. Once an educator completes a Master's degree program, he/she is set up in "Virtual Academies" to have a multiplying effect. "Virtual Academies" are an innovative part of what Monterrey Tec does in its Social Development programs. A graduate receives technological training and then is placed in charge of tutoring 25 teachers in the area of his/her educational expertise. Through the associated multiplying effect, Monterrey Tec reports that a half million teachers have improved the quality of their educational techniques.

The Social Development Programs of the Virtual University also offer courses for school administrators and for parents. In terms of parents, there is a need to consider their personal development, and to give them some understanding of how to use information technology. In Mexico, there are many parents who have never before seen a computer. Monterrey Tec has discovered that when the parents get trained, the teacher gets much more respect and support from the parents.

Training for Public Officials, NGO's, Journalists, and Communicators

The Social Development Program offers courses for public officials and the staffs of non-profit organizations, journalists, and communicators. For example, mayors elected in Mexico usually are in office for only 3 years, and likely have no previous experience in government. Monterrey Tec offers the new mayors a training program providing concrete step-by-step directions, indicating what needs to be done in the first 100 days as a mayor. There is also a course on ethics—how to fight corruption. In addition, there are programs for journalists and communicators with the objective of enhancing the integrity and professionalism of social communicators in their daily jobs as spokespersons for the different national realities.

Community Learning Centers (CLCs)

The program most directly linked to poverty reduction is located at the local CLCs. In 2001, Monterrey Tec sought to apply what they had learned about distance education and put it to the service of the poorest, most isolated people in Mexico. This was met with major resistance by many in Mexico. They could not understand how Monterrey Tec could expect people in poor, isolated communities to learn by using the computer. However, the university decided to prove those people wrong, and leaders there believe that they have done just that!

A typical CLC is simple, somewhat like the telecenters described above: just a 10 by 10 room, with between 4 and 15 computers connected to the Internet. The goal was to develop the centers in especially low-income communities that are geographically isolated. Starting out, Monterrey Tec went to the most isolated places; they knew that if they could make it work there, then they could make it work everywhere.

Most of the CLCs are operated in partnership with the government, especially with the Department of Education and the Ministry of Social Development. Once a village or town has a CLC, the community can use it in any way they want. A CLC can bring 10 computers into a very isolated place and link inhabitants to high speed, 128K Internet, which is very high speed for these communities. As a result, the community begins to change and transform. The content offered by the Virtual University for these Community Learning Centers include: a basic computer skills course; a virtual high school degree; a Bachelor's degree; a Master's degree for teachers; a management skills program, a community development program, and continuing education courses.

The long-term, target goal of the CLC initiative is to develop a core group of community leaders in each rural area, including teachers, municipal authorities, small entrepreneurs, etc., and to provide them with skills or information that can help them improve the conditions of their respective communities. It is hoped that the Learning Center in each community will grow into a self-sustainable center where local people can manage and administer all the processes. Monterrey Tec would continue to train the center promoters and to provide educational content and tutoring, all in a distance-learning manner.

Figure 1 depicts the CLC student-centered learning environment with access to online education.

Illustrative Examples from China

Now in an effort to narrow and clarify the discussion, we will focus on a small number of specific CLCs that we visited, first in China and then in Mexico. We ask the reader to keep in mind the fact that, at the time of our visits, the Monterrey Tec program had been operating for less then 3 years while the Tsinghua University program had been operating just over 1 year.

Two representative sites that we visited in China were the program in Huade County, Inner Mongolia and the program in the Yuanzhou District of Ningxia
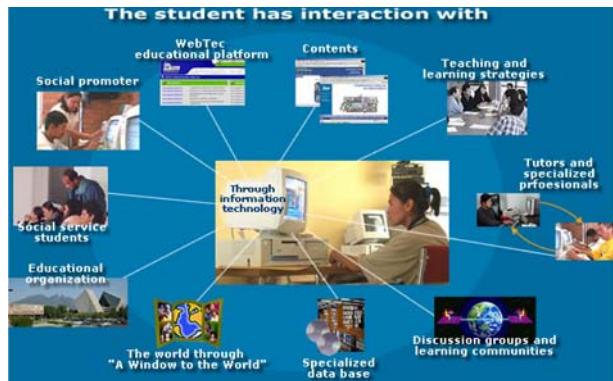

Fig. 1. Student-centered learning.

Province. The CLC in Huade County and the main center, or "Distance Learning Center," in Yuanzhou District are both located in small cities, the seats of their respective county governments. Extremely poor, rural villages surround both of these cities.

Huade County, Inner Mongolia

The CLC of Huade County opened in September 2003. This CLC did not have Internet connectivity, but rather utilized satellite technology to download educational content for storage on local networked computers. During its first year of operation, the center enrolled 153 students in four courses, including: Leadership Skills Improvement; Enterprise Management; Judicial Officials Training; and Education Finance and Management. That first year, they also held a college entrance examination program that enrolled 786 students and a primary and middle school English teacher training program that enrolled 56 students.

In the second year of operation, starting in September 2004, the center enrolled 111 students in four courses: Education Finance and Management; Applied Computer Technology; Civil and Commercial Law; and Enterprise Management. Also in September 2004, the Huade County center offered a 3-month program of teacher training provided by Tsinghua University. This program included four courses for teachers: Adolescent Psychology, taken by 39 teachers; Textbook and Teaching Methods of Primary School Chinese, taken by 45 teachers; Textbook and Teaching Method of Primary School Mathematics, taken by 43 teachers; and Reform of the Course and Textbook of Ideological Education, taken by 51 teachers.

In June 2004, the Huade County center participated in a distance learning program assessment done by the School of Continuing Education at Tsinghua University. Also in June 2004, the School of Continuing Education sponsored a daylong videoconference that brought together 13 officials, including officials from the county government, local industry, and the department of local economic development. As a result of the assessment and the videoconference, the Huade County center made the following changes to its operations:

- Employed a technician in charge of communications with Tsinghua University;
- Employed technicians to receive and play the distance education software;
- Changed schedule of courses to coincide better with scheduling needs of potential students;
- Appointed one advisor for each class, to insure that student educational needs are met;
- Arranged to have two technicians in charge of daily technical maintenance and helping students with equipment.

We had an opportunity to interview several people who had been enrolled in the Tsinghua continuing education courses, including teachers, government managers, and those in the legal profession (see Figure 2). In general, they were positive about the learning experience so far and enthusiastic about receiving the excellent content from Tsinghua University. However, there did seem to be some broad dissatisfaction with the inflexible scheduling of the learning programs that made it difficult for many to attend. Unlike the usually unscheduled nature of learning in CLCs in Mexico, the Huade County system required attendance in regularly scheduled classes.

Fig. 2. Learners and leaders associated with Huade county CLC.

The Huade County center reported that its continuing problems were as follows: a need for more multi-media content; CD burners so that courses can be repeated on a flexible schedule; a problem with low attendance; and textbook materials that do not match the distance education coursework.

Yuanzhou District of Ningxia Province

At the onset, it should be clarified that upon the start of the Tsinghua Education-to-Aid-the-Poor Project, Yuanzhou district was far more advanced than Huade County in the area of distance education. Since 2000, Yuanzhou district has been involved in two national projects—"Applying Information Technology in Education" and "Modern Distance Education in Rural Areas"—both of which are funded by the Chinese government in partnership with certain international organizations. Therefore, by the time that Tsinghua introduced its program in Yuangzhou, the district already had a technology infrastructure in place, was familiar with the idea of distance education, and had some positive experiences with distance education. It is for these reasons that Yuanzhou district was chosen to be the pilot program for Tsinghua's three-level training and teaching program to aid the poor.

The Tsinghua Community Learning Center, or "distance learning center," is located in the city of Guyuan, in the district's education training center. Classes began in September 2004, only 1 month before our visit. Supported by its advanced distance education platform connected to the CERNET, Tsinghua University introduced a two-way, interactive video learning system to the Yuangzhou center. In partnership with Tsinghua, the School of Continuing Education equipped nineteen primary and middle schools with distance learning resource receiving systems, televisions, and DVD players. These school computer centers have satellite dish technology, providing a one-way, downloadable connection to the "learning center" in Guyuan.

With the "distance learning center" as the headquarters of project implementation, the 19 schools mentioned above were chosen to be pilot sites for the widespread dispersion of knowledge in rural villages. The implementation process involved the following three-level training and teaching network: (1) Yuanzhou District built the learning center, plus a homepage for it, making the center into a training, teaching, and demonstration service center for the

public; (2) the district built learning support centers in Zhanyi and Touying Middle Schools that serve a managing, coordinating, and advising function at the village level; (3) the district built learning support centers in 14 primary schools that serve a similar function in those villages. At the time of our visit, the district had provided training for the learning support center managers only in Zhangyi and Touying towns to specify their responsibilities and to insure that the village's distance education resource was available to all villages and families. This networked three-level organizational structure is depicted in Figure 3.

The Yuanzhou District assumed responsibility for publicizing the courses through several avenues. The district also announced that performance in the courses would be considered in the yearly cadre evaluation. During its first session of operation, the Tsinghua distance learning project had the following number of students enrolled in its courses: 161 students in the basic computer technology course; 406 students in the courses for primary and secondary school teachers; and 252 students in the Adolescent Psychology course.

We had the opportunity to interview a large number of teachers who had been involved in the above training. They were generally positive about the courses they had received so far, expressing a belief that the high quality content from Tsinghua would positively impact their teaching capabilities. In particular, teachers were very enthusiastic about the Adolescent Psychology course that was presented in a real time, interactive format by video-conferencing. An expert in the field of adolescent psychology from Tsinghua University taught the course, and we

gathered from our interviews that the teachers found the expert's child-centered approach to education to be something new and valuable. During our visit, we were not made aware of any educational programs for farmers or families available in the 19 pilot village support centers.

At the time of our visit, the district identified the following project needs:

- Annual budget supplement of $2439 for project-related teaching expenses.
- They would like Tsinghua to find partnering Beijing schools for their neediest primary and middle schools.
- They had an urgent need to get resource CD's for primary and middle school education, practical skills training for farmers, and education for the villages' communist party members.

Typical learning-engaged middle-school learners are shown in Figure 4.

Examples from Mexico

Dr. Arroyo, Nuevo Leon

The community learning center of Dr. Arroyo was the first center in Mexico's 1000 plus network of centers and for this reason, it continues to be a flagship center of the CCL Program. In late 2001, the citizens of Dr. Arroyo requested virtual education courses from Monterrey Tec, and the initial concept of the CLC Program derived in part from that request. Dr. Arroyo is a medium-sized town (population approximately 10,000) about 5 hours drive time from Monterrey and, like the two Chinese cities cited above, is surrounded by poor, rural villages. It should be noted here that much of the population of this
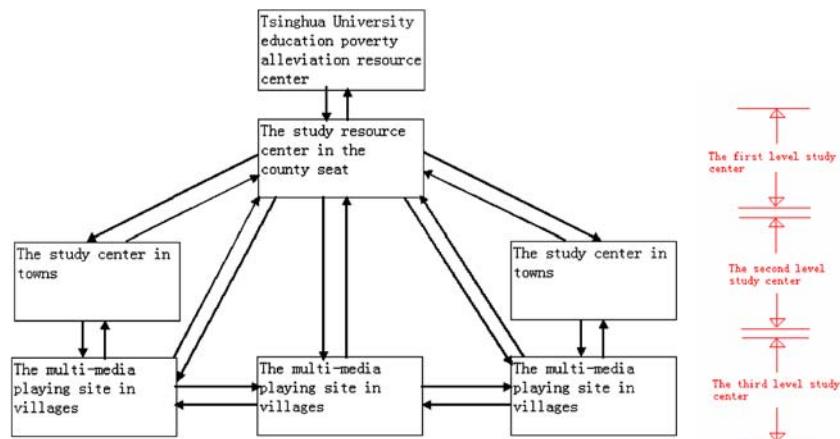

Fig. 3. Three-level networked organizational structure in Yuanzhou District.

Fig. 4. Students using multi-media in a village middle school in Yuanzhou District.

town and the surrounding villages is female, since the many working-age men are in the US, sending money back to their families. The Dr. Arroyo CLC is the largest center we visited, with approximately 15 computers. The center facilitator was very enthusiastic about the level of utilization by the community and pleased that a wide variety of courses were being accessed. The town of Dr. Arroyo does have a commercial cyber café, thus providing citizens with additional access to ICT services.

This CLC, and the others that we visited in Mexico, is connected to the Internet by two-way dish satellite technology. Via the Internet, the centers are connected to the Virtual University's WebTech course administrator platform; the digital signals are aggregated at the main room of the center, where a standard rack of equipment includes modem, router and hub. In that way, each of the computers in the CLC is connected to the Internet via a local area network within the CLC and connected by satellite to the Internet. A recurring problem in some of the Mexican CLC's is lack of precise aiming of the satellite dish, causing intermittent loss of connectivity. We could not determine if this incorrect aiming was due to slow drift in aim, poor installation, or some other process.

The three most popular educational programs at the Dr. Arroyo center are: Basic Computer Skills; Virtual High School; and Continuing Education courses for teachers. The Basic Computer Skills course is required first, before enrollment in other virtual courses. It has a flexibly scheduled, online format that each student can follow at his or her own

pace. This course is made up of a large number of modules, and after completing each module, students receive a certificate of competency in the particular computer skill area. These certificates are valuable tools in securing employment for graduates. Recall our 10-year-old student? This is the certificate that she earned!

The second popular program at Dr. Arroyo is the Virtual High School, a 3-year program divided into nine 4-month periods (Figure 5). Unlike the Basic Computer program, this is not a flexible, self-learning course, but rather, it is a formal educational program whose nine 4-month periods begin and end on specified dates. This is a challenging program with assignment deadlines and a difficult curriculum. As an example, students are required to take two periods of chemistry, two periods of physics, and a course in both differential and integral calculus. The rigor of the coursework has been overwhelming for some students, especially in a rural world where ICT infrastructure is not always reliable. Assignment deadlines have been missed when the system was down, and students have been known to travel for 2 or 3 hours to the nearest CLC where they could send a completed assignment back to Monterrey. Therefore, while a large number of students enrolled in this program at Dr. Arroyo, many have dropped out along the way. The center saw its first five students graduate from the Virtual High School in December 2005. Of course, there are other students at the center who are at different stages of the Virtual High School program; we met a 50-year-old woman, the principal of a local elementary school, who was working to get

Fig. 5. Elizabeth Murray speaking with a student from the Virtual High School Program.

her high school degree. She eventually hopes to get her Bachelor's and then a Master's in Educational Counseling, all through the CLC.

One very popular and effective aspect of the Virtual High School program is its system of online tutoring. Online tutoring is a critical element of all the formal educational programs of the Monterrey Tec's Virtual University. Therefore, it is a part of all the formal educational offerings of the CLC's (High School, Bachelor's, Master's Programs) but not a part of the more flexible, self-guided continuing education offerings at the centers. Most of the tutors in the Virtual High School Program are university students from Monterrey Tec who are fulfilling a community service graduation requirement by tutoring. On average, each tutor works with 20 geographically dispersed high school students, providing assistance, support and encouragement via e-mail and online chat. The high school students have at least one opportunity to meet their tutors in person, to put a face upon the virtual presence. All of the students we interviewed at Dr. Arroyo were extremely enthusiastic about their tutors, believing that they could not have succeeded without such personal online help.

A third popular course offering at Dr. Arroyo is the Continuing Education Program for teachers. Two or three of the people we interviewed at the center were involved in these courses. Again, this is a flexible, self-guided learning experience that teachers can do at their own time and pace, although there are assignment and exam requirements for course completion. Some of the continuing education course offerings include: Strategies for the Effective Teaching of Mathematics; Statistics for Teachers; Education in and for Diversity, etc. A more advanced and challenging program offered for teachers is "Educational Competencies for the 21st Century" which was developed by Cambridge University in Great Britain and provides Cambridge certification upon completion.

During our visit to Dr. Arroyo, the CLC computers were busy with a variety of users. Six students were enrolled in the Virtual High School Program, while three teachers were working on the Effective Teaching of Mathematics curriculum. In addition, a policeman dropped by to work on the Basic Computer course and a few local school children were using the computers to do homework. An 8-year-old girl whose mother had been taking her to the CLC for 3 years demonstrated her self-learned PowerPoint prowess; her mother was planning to obtain a high school diploma later in 2005.

There were two problems reported to us during out visit at the Dr. Arroyo CLC. The first—difficulty maintaining the computer technology—is a problem encountered at all 13 centers we visited. The second problem related to the Virtual High School Program. While individuals enrolled in that program considered the course content to be excellent, they found the assignment scheduling requirements too rigid for the rural, target population, especially in light of a frequently unreliable technology. Figure 6 shows the people with whom we met at Dr. Arroyo.

La Asuncion, Nuevo Leon

La Asuncion is a small and poor rural village about 1 hour drive from Dr. Arroyo. Much of the village's male population is working in the US. The CLC is located at the middle school and contains approximately seven computers, although one was broken and had been out of commission for quite a while (Figure 7). We visited on a Saturday, a day when the center is not usually open, and that may account for the low level of center utilization. However, the center facilitator who greeted us appeared generally discouraged by the village's failure to utilize the ICT resources.

On the day we visited, there were five users at the CLC. One 50-year-old woman was about halfway through the Virtual High School curriculum. She was extremely grateful for this opportunity to study and very enthusiastic about the role of her tutor in the process. Her dream is to achieve an online Bachelor's degree in psychology from Monterrey Tec. The facilitator informed us that there are three additional
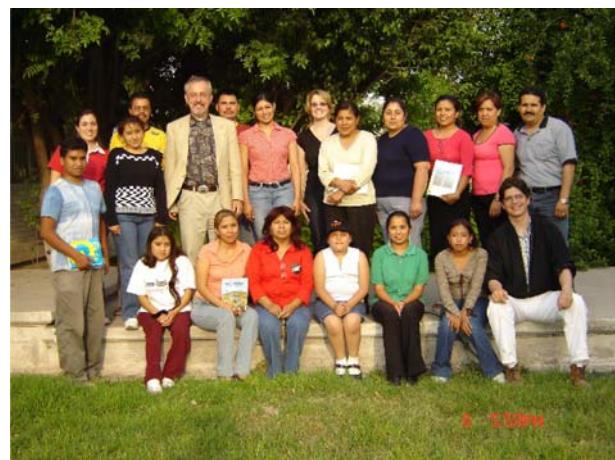
Fig. 6. Learners and staff at Dr. Arroyo's CLC #1.

Fig. 7. CLC located in rural school in village of La Asuncion.

village residents enrolled in the Virtual High School Program. Two other users that day were primary school students accessing an online web site created by Monterrey Tec to enrich math skills. The final two users included a university student, home for the weekend, and a teenager playing video games.

Although the CLC is located in a middle school, there appeared to be no relationship between the school and the center. The facilitator reported that none of the teachers use the computers for continuing education courses, or even for other professional or personal matters. Furthermore, the teachers make no attempt to integrate the ICT's available at their school with their educational curriculums, nor do they encourage students to use the computers to augment their learning. Although the facilitator himself is a teacher, he had no idea how to improve this disappointing situation.

A primary function of this CLC is as a public computer café for the isolated village. It is used largely by young people—by middle school students boarding during the week at a nearby dorm, and also by youths from the village. According to the facilitator, many users have enrolled in the Basic Computer course, but only a handful have completed it and received certification.

Summary Chart

Table I provides a breakdown of the four featured learning centers discussed above, two in China and two in Mexico, on the basis of 10 characteristics described below that we consider important for the long-term success of any learning center initiative:

(1) *Development goals*—What are the short-term and long-term impacts that the program hopes to make?
(2) *Partners*—Does the CLC program have broad enough partnering to lead to comprehensive social and economic development?
(3) *User population*—Through what population is the CLC trying to make an impact?
(4) *Planning process*—To what extent are actual users involved in the planning process of the CLC?
(5) *Access*—To what segments of the population will the ICT services be available?
(6) *Services provided*—What specific services will be offered?
(7) *Utilization*—Have the services offered been utilized by the targeted user population?
(8) *Community awareness of ICT's value to them*—Does the targeted user population clearly understand the value of the ICT-related services available to them?
(9) *Plan for community participation*—Does the program have a strategic plan for increasing community participation?
(10) *Clustering of Community Learning Centers*—Is the larger educational network of Community Learning Centers divided into smaller, regional networks that can share resources, practice ideas, and support?

FRAMEWORK FOR DECISION MAKING

> Never tire to study—And to teach others.
> Confucius

Both of the programs we have described above are new, still growing and defining their missions and activities. Leaders of both programs have admitted to problems in implementation, not unexpected with such ambitious and spatially dispersed programs.

Neither of these distance-learning programs is unique to their countries. In Mexico, the federal government provides other systems for distance learning, and in China both the central government and government-affiliated universities offer distance-learning programs. In fact, we believe that China has educated more students via distance learning than any other country, with millions taking distance learning courses from over 50 distance learning programs now existing in China. There is no way that we

Table I. Summary of Key Descriptors of Four Implementations

	Huade County	Yuanzhou District	Dr. Arroyo	La Asuncion
Development goals				
Short-term	Spread knowledge	Spread knowledge	Access to education	Access to education
Long-term	Eliminate poverty	Eliminate poverty	Promote equity and development	Promote equity and development
Partners	Tsinghua U.; Service Center of China's Poverty Alleviation; UNESCO; World Bank Institute; Provincial and county education officials	Tsinghua U.; Service Center of China's Poverty Alleviation; UNESCO; World Bank Institute; Provincial and county education officials	Monterrey Tec; Dept. of Education; Ministry of Social Development; State and local community leaders	Monterrey Tec; Dept. of Education; Ministry of Social Development; State and local community leaders
User population	Gov. officials; teachers; farmers	Gov. officials; teachers; farmers	All community members	All community members
Planning process	Top-down by university, provincial and county officials	Similar to Huade county but limited top-down due to extensive initial needs assessment	Bottom-up by community members requesting services	Limited bottom-up with community members accepting offered services
Access	Courses for gov. officials, teachers, farmers	Courses for gov. officials, teachers, farmers	Courses open to all community members	Courses open to all community members
Services provided	Continuing education for teachers and gov. officials	Continuing education for teachers and gov. officials	All Monterrey Tec course offerings to CLC's, as well as various ICT services	All Monterrey Tec course offerings to CLC's, as well as various ICT services
Utilization	Initial course offerings well received by user population	Initial course offerings well received by user population	Wide utilization of courses available from Monterrey Tec and other services provided	Marked under-utilization of resources available from Monterrey Tec
Community awareness of ICT's value to them	Awareness limited to selected user population	Awareness limited to selected user population	Initial successful community awareness; must be ongoing	Limited success of community awareness; must be ongoing
Plan for community participation	Publicity to target population; participation tied to cadre evaluation	Publicity to target population; participation tied to cadre evaluation	Publicity left to discretion of center facilitator; no pressure or incentives to participate	Publicity left to discretion of center facilitator; no pressure or incentives to participate
Clustering of CLC's to share resources and support	Isolated center receiving one-way courses from Tsinghua U.	This pilot project has one teaching center as the central point of a network of 19 receiving centers	Central center in a very loose network of rural, village centers	Isolated center, not strongly networked with Dr. Arroyo center

could cover all of these ongoing programs of China and Mexico in one paper.

In the remainder of this paper, we focus on the specific distance learning programs of Monterrey Tec and Tsinghua. We feel this is appropriate for a variety of reasons. First, we believe that these two programs represent the state-of-the-art in distance learning as offered by universities and focused on

economic development and poverty reduction. Second, both universities are premier universities in their respective countries. Third, since each program is still emerging, the time is right for taking an early look at "how things are going," leading to suggestions for improvements. Fourth, we may be able to suggest frameworks for each program to become a "self-learning organization," so that each by monitoring its on-going performance may be able continuously to improve.

This is not a formal evaluation. We do believe that a more conventional outside evaluation should be done on a recurring basis, perhaps every 2–3 years. Some of the points we discuss here should be included in a more formal evaluation.

We now offer 12 steps leading to system performance measures for continuous improvement and periodic outside formal evaluations.

Conceptualize the Overall Program Design as a Complex System

Conceptualize the overall program design as a complex system having multiple objectives and numerous constraints. Education is an investment in people, embedded in their complex networks of human inter-relationships with many multifaceted goals and objectives. We need to think of any educational initiative as part of a larger holistic system or process in which education is a part. The management strategist, W. Edwards Deming, once said, "If you can't describe what you are doing as a process, you don't know what you're doing" (Deming, 1982).

Few disagree that education is the most important investment a country can make in its people. The strategic plan of every CLC must be linked to national development objectives. In this light we must think of educational impact as generational, taking place over decades.

In viewing the network of 1200 + university-affiliated CLCs in China and Mexico as a multi-generational system or process, we need to think about system inputs and outputs. Inputs are the learners who come to the Centers for various types of education. Outputs are the educated learners who complete courses or modules, or they may be "dropouts" who do not complete selected programs. For the inputs, we need to think about their ages, stages in life and thus their educational needs. Some may require certification, others only knowledge. For the outputs, we need to think about systems and processes that need to be in place to leverage the

newly found knowledge. Jobs are important. Building a career is important. Improved productivity can result from the newly found knowledge. Entrepreneurialism may be a ticket to a new life. But increased knowledge with no place to use it is discouraging and will become known by others who, in turn, will choose not to invest their time in a process for which there appears to be no real payoff. These systems linkages will undoubtedly require communication with a variety of other governmental and private sector organizations. In both Mexico and China, there is the need to have strong coordination between the universities and the respective Ministries of Education. In Mexico, there is additional coordination with the Ministry of Social Development. Both too should be strongly linked to the private sector, to maximize the chances that successful graduates will have jobs waiting for them when they graduate, or that they be encouraged and tutored to start their own businesses.

Our impression is that the Chinese "system" for economic development and poverty reduction is meant to be comprehensive. In the two provinces that we visited, the broader system included incentives for peasants in land-poor areas to relocate to be near urban centers, providing new housing and more productive agricultural ventures compatible with their new locations. It also included substantial new infrastructural investment in provincial cities, providing parks, wide streets, new hotels and housing and other amenities, making these centers attractive for economic development and inland migration. New world-class highways were being constructed to connect the provincial cities. While the Tsinghua educational initiatives were not described to us as a formal part of this larger system, due to the wide breadth of governmental planning in China, we see it as part of a much broader effort towards economic development in western, poorer provinces. Mexico too has a broadly based national goal of poverty reduction and economic development, but we did not see the types of substantial infrastructural investments in Mexico that we witnessed in Inner Mongolia and Ningxia.

Regarding jobs, all of the adult learners we met in China were already employed. In Mexico, most learners in the CLCs were not currently employed, being either housewives and mothers or young people of high school or college age. Both programs have the "systems need" to embed the e-training into a jobs-creation or jobs-enhancement effort, so that successful graduates will find jobs or improve their

job situation, thereby attracting more learners into the systems.

Establishing Awareness in the Community of CLC Benefits

A major challenge facing CLCs around the world is how to raise awareness among the target audience of the valuable educational services available to them.

A majority of the 13 Centers we visited in Mexico appeared to be significantly underutilized by the community. What seems to be needed is a public relations campaign, and this should be another important part of ongoing facilitator training. Given that most of the target audience has never even seen a computer, it cannot be expected that they will immediately understand the inherent value of ICT's. It is ultimately up to the facilitator and partner organizations to determine how to make this connection.

The Tsinghua system has adult learners who were currently employed as administrators or teachers in schools or in leadership positions in local government agencies or involved with local businesses. Many were using computers for the first time. In our view, eventually these centers also should be connected to the Internet and opened to the public, with the type of community awareness campaign that we advocate for Mexico.

In each country, leaders should develop a plan for community support. Research and experience have shown that it is critical to have bottom-up, demand-driven development objectives. When opening a center, there should be a "road show" available to the local CLC facilitator, to engage and excite local potential stakeholders. Educate facilitators on how to create community interest, how to assess local demand for various types of content, and how to generate local financial support.

Market Assessment and Segmentation

Education is a service industry. Services are consumed by "customers" in response to perceived need or desirability of that service. Even if tuition and fees are absent, the time of the student or learner is a valuable asset and will be apportioned carefully. In the USA, a Hollywood film about baseball (*Field of Dreams*) popularized the phrase, "Build it and they will come." This may have worked in the film, but it will not work automatically in CLCs. More appro-

priately, the phrase may be, "Build it and they will *not come* unless you offer them what they want and need." Experience in other countries has shown that CLCs may cease to exist if insufficient attention is given to identifying and serving local needs. There are many CLCs in Africa, South Asia and elsewhere that have died due to a lack of community focus.

Each community that hosts a CLC has its own educational needs. This is true in China, Mexico, or anywhere on earth. Some desire high school completion and certification. Others want to develop proficiency at using computers. Others may want farming information, including world pricing for various agricultural goods. Others who are parents may need guidance about supporting the education of their children. Many, as in China, will be teachers who want to improve their teaching skills. Some will want training in starting and running a business. Most will represent a combination of needs, of "market demands." There is a need to do a careful *Market Assessment and Segmentation* of local demand. A highly trained and professional local facilitator should be able systematically to assess community information needs, and be creative and entrepreneurial in dealing with those needs.

Market assessment should include not only need for content but also identifying *supporting social structures* to deliver that content. One has to realize that learning from a computer can be isolating, unfamiliar and not much fun. Not realizing this fact may result in unacceptably large dropout rates. China's Tsinghua program emphasizes scheduled group classes, and this aspect creates a familiar and comfortable social structure. Mexico's program lets the local Center's facilitator decide about scheduled classes, meaning some Centers have scheduled classes and many do not.

The hours of operation of each Center should be adjusted to account for local people's lifestyle constraints. In Mexico, we saw Centers that were closed on Saturdays and Sundays, precluding participation of prospective adult learners who may have time available only on weekends. It may be better to close on a Monday or Tuesday than on weekends. Or, the Center could be open every day, with a "floating facilitator" available to fill in on an as-needed basis on those days when the regular facilitator has scheduled time off. In China, where the Centers were not always open to the general public, learners seemed to be grouped in classes, and the hours of operation were coordinated with the scheduled classes.

Location Analysis

The types of learners drawn to the Centers are quite dependent on the Center's location in the community. In Mexico we visited Centers that were located in junior high schools, in libraries, in community Centers and in Monterrey Tec itself. Some were in the town center whereas others were far from the center. Movements of the centers from one location to another were not rare events. In Inner Mongolia and Ningxia provinces, we visited Centers located at local Communist Party Headquarters, in teacher training centers and in schools.

Ideally one needs a careful evaluation of prospective Learning Center locations to see which model likely will be most successful in each community. Our observation in several of the Mexican Centers was that adults tended *not* to go to Centers located in schools, especially if the schools were distant from the town center. If the market assessment points to the need for significant adult education in the community, this may suggest a location other than in a school. In China, having the Centers at local Communist Party Headquarters may be a good decision initially, as previously identified leaders in education and government need to be the first to be educated by the system, but may have to be revisited later—when a broader segment of the community may need to be drawn into the Centers. Asking the question, "Where do people naturally congregate in this community?" may also influence location of the Center.

Balance Center Capacity with Local Demand

Education is a service industry, similar in many ways to banking, postal services and even restaurants. When such services open in a community, managers try to assess local demand for their services, and thus adjust their *service capacity* for customers accordingly. Building too large a Center wastes money, as an overly large Center will be underutilized. Building a too small Center will discourage potential learners due to long waits for computers and tutors, thus not serving well the local community. The search is for a reasonable tradeoff between service access and capacity restrictions—to balance benefits and costs.

One key measure of Center capacity is the number of computers for use by the local learners. Many dropouts in the Mexican town of Galeana were due to the fact that only four computers were located there, resulting in many students waiting to get on-line. This was unfortunate since the Center started out with a group of 35 in a computer proficiency course, but most ended up dropping out due to lack of computers. Our experience in other settings is that once the early customers get discouraged, they drop out from the system forever and tell others not to bother to try the new system. We do not have first hand knowledge of the methods for assessing local computer needs in the Tsinghua system. However, we did witness much heavier use of television, live and videotaped, in China's learning centers, especially in those rooms arranged as traditional classrooms. Not all learning needs to be done on a computer connected to the Internet, and finding the right balance of delivery technologies is part of the larger problem of capacity planning.

There are at least two ways to improve the match between supply and demand for computers in each Center. The first is to do a better job at gauging local demand before opening the Center. The second is to monitor demand as it appears and attempt to do adjustments by removing computers from underutilized Centers and adding computers to Centers having more demand than expected.

Technology Maintenance, Repair and Replacement

CLCs are often located in towns or villages with little or no previous experience with computers. There is a huge challenge to keep the computers and all the related network and telecommunications technology in good working order. We heard complaints from local administrators in both China and Mexico that the "maintenance and repair systems" for such technology were not yet working to the levels desired.

In Mexico, a broken computer in one CLC required one full year for repair. In another, the facilitator herself drove twice to Monterrey to deliver a broken computer. The trip was 2 hours each way. In each case, she had to drive back to Monterrey 1 month later to get the repaired computer. In addition to computer maintenance, there is the required maintenance on Internet hardware and software, including routers and satellite dishes. As one recurring problem, Internet connectivity was often down due to misalignment of the satellite dish. There is a strong need to devise a better way of repairing and maintaining computers and local networks.

China reports identifying teachers in schools who are most familiar with educational technology. They are trained to be able to make basic repairs on most equipment. Mexico tries to do this with the local

facilitators, so that local personnel can fix simple recurring problems. But higher-level technologies usually require a certified technician.

One way to decrease the time needed for computer repair is to place in regional warehouses an inventory of working (fixed) computers, ready to be sent to Centers having broken computers. One takes broken computers and exchanges them immediately with good ones from the inventory. In that way, the 1-month to 1-year delay times will be reduced to essentially the time to get to the location and do the exchange.

Computers require replacement every few years, as they become obsolete. This fact too causes expense and creates the need for a computer replacement system. As a simple thought experiment, suppose there are 8000 computers in 1000 Centers, corresponding to an average of eight computers per Center. Suppose also that the useful life of a computer is 4 years. We want to replace computers continuously over time, not all at once, which would be logistically very difficult and would wreak havoc with annual budgeting processes. Continuous replacement of computers means, in steady state, that 2000 computers will have to be replaced with new ones each year. The computers in 250 Centers will be upgraded to new ones. Since there are about 250 working days in a year, that means that on average, one Center per day will get new computers—in steady state and assuming no further growth in the system. Such an intense replacement cycle requires a major system design just to do that. We are not aware that either China or Mexico has such a system in place at this time.

We also suggest that courses be offered in technology maintenance and repair in the respective e-learning systems in both China and Mexico. Certified graduates of such courses could start new businesses in the towns in which they live, perhaps with the first guaranteed jobs being computer maintenance and repair work for the local CLCs! But more generally, developing local expertise in technology maintenance and repair would accelerate the local adoption of technology more broadly though the population.

Qualify and Certify Center facilitators

Each CLC needs a full time *facilitator* acting as local manager, general tutor/mentor, and promoter of the center to local residents. In both Mexico and China this position should be professionalized with a career path for further advancement.

In Mexico we met nearly 20 facilitators. We found many to be hard working, truly dedicated professionals. They were people "on a mission." Successful ones often structured learning opportunities by creating learning teams meeting weekly. This scheduling is similar to the methods used in most Chinese centers we visited. Other Mexican facilitators were less professional. Some were discouraged by lack of community interest, or lack of sufficient numbers of computers, or lack of a system to speedily repair computers and Internet equipment. Some of the promoters we met had not even been certified in the introductory course on computer literacy, yet they were trying to get "students" in their Centers to take this course and become certified.

Given the critical role of facilitators in fostering development and achieving Center sustainability, there should be a facilitator-training course requiring an examination for certification. While technical training for facilitators is important, knowing how to link the Center to community development efforts is also important. Facilitators should become a certified profession, with demanding standards and a career path.

We suggest, following the model in Mexico's town, Dr. Arroyo, that regional networks of CLCs be created whose facilitators could be connected both online, and occasionally in person, to share best practices, content ideas, marketing strategies, day-to-day frustrations, etc. We also suggest that all facilitators be made to feel like a national community of dedicated professionals. Why not give each a web page, centrally created but with his or her own inputs? Other facilitators could search through this database by location of Center, special interests and qualifications of facilitators, or other key words. As another step towards professionalism, there could be central or regional, annual face-to-face group meetings of the facilitators to share experiences and best practices, etc.

Volunteers could be used to extend the reach of the facilitators both in the Center and also in the community. Volunteers could be drawn from different community sectors—education, health care, and business—and could serve as bridges to those sectors.

Student Achievement

Properly designed, students taking courses at a distance from the instructors can do just as well or better than those in traditional classroom face-to-face settings. Both China and Mexico need to establish

rigorous systems for tracking the learning accomplishments of their students. At the time of this writing, China had sent us some useful aggregate statistics while Mexico had not yet sent us similar data for its much larger program.

One key statistic relates to student attrition or "dropout" during the time that a course is offered. Experience worldwide has shown that if nothing is done to reduce dropouts, it is not unusual for 70% of distance-learning students to drop out before completion.

For Mexico we have requested but not yet seen any formal data on dropouts from the Monterey Tec CLC system. But our belief is that there are too many dropouts from the system. Even in the successful town of Dr. Arroyo, four students were the first to obtain high school diplomas in December (2005). But we believe that originally about 30 students signed up for this program. That is a dropout rate of 26/30, equaling 87%. Planners of the system must ask, "Why so many?" "How can we retain more?" "What lessons have we learned since starting ways to retain these students?" "Have we changed our approach as a result of these lessons?" "In what ways?"

In our visits to Mexican Centers, we saw that dropouts were caused by several different factors: technology limitations (e.g., too few computers and thus lengthy delays to access them, slowness due to low bandwidth, erratic connectivity to the Internet); loneliness due to lack of feeling that one was with a community of fellow students; lifestyle changes that precluded further participation (e.g., a family member becomes ill and requires care and attention from the student). Those who design and operate the system can address many of these concerns.

Only one or two of the Learning Centers we visited in China reported student dropout rates. In their first year, starting September 2003, the program in one Center enrolled *152 students in 4 classes, 33 in the class of cadre's governing capacity training, 23 in the class of business administration, 24 in the class of justice, and 72 in the class of educational economy and administration*. At the end of the first term, 117 students took and passed final exams. The attendance rate for the final exam was 76.9%. Thus, the dropout rate was 23.1%, very low for distance-learning students. One should note that these classes were offered at scheduled times with class members meeting together. This is in contrast to the system in the Mexican CLCs, where the great majority of learning is via two-way Internet connectivity but without the presence of local classmates at scheduled class meeting

times. It should also be noted here that attendance in the Chinese courses was tied to cadre evaluation.

Educational research has shown that embedding a student in an online community of like-learners can significantly reduce dropout rates. With any of the courses or modules available in the Centers, we believe that there should be efforts to develop online communities, where the students are able to discuss the material together or work on projects together. That step could go a long way towards decreasing dropout rates and improving learner satisfaction.

Planners could try *competition* as a way to provide incentives to facilitators and learners. One possible measure of competition could be numbers of learners taking courses or modules *and* completing them. This would enhance retention of learners, decreasing dropout rates. Another source of competition could be in designing web pages. Suppose that each Center has its own web page and that page is the best of designs submitted by locals. That may enhance interest and give a sense of local pride and identity. Winning Centers—based on student achievement, web designs or other factors—would receive awards and perhaps some forms of scholarships to its best learners.

Tie between School Location and Teaching in the Schools

Since education is the key purpose of CLCs, it is clear that they must have strong ties to local schools. In China, in the Yuanzhou district pilot project, this is accomplished by a regional networked organizational structure that fans out from a central fully equipped learning center to rooms in schools equipped with lesser technologies. The central facility resembles the generic CLC as we have been describing it. The lesser facilities may only include a subset of the following: television, VCR, overhead projector and CD player, computers not connected to the Internet but possibly arranged in a local area network configuration. Many of the "students" in the central center are teachers from outlying towns and villages. In some cases, the "students" who are teachers, in turn teach other teachers when they return to their schools. This system design has an appealing cascading, multiplying effect. Mexico's new online Masters program for teachers also has a cascading effect—as the new Masters graduate must train 25 additional teachers.

Many Mexican Centers tend to be located in middle schools. If they are located in a school, then

the school should utilize the Centers in significant ways. This is especially true for Centers in schools far from town centers, meaning that adults will tend not to visit the Centers. But, from what we observed, there is little tie between the Center and what happens in the schools. School educational programs tend not to utilize the Center's technology, beyond the fact that students may use Centers to do homework. Recognizing that there always are exceptions, teachers tend not to use the Centers. For example, in El Charquillo, the Center was in a middle school but the teachers made no use of it. When we asked about this, we received a variety of answers. One (paraphrased) answer was this: *Teachers work many hours per day and do not have significant extra time to sit in the Centers and learn about computers. And, they are not encouraged to do so, as their salaries are not linked to increased proficiency with computers or to their using computers in their classrooms.* Another less encouraging (paraphrased) answer focused on the generation gap between "oldsters" and youngsters: *Teachers do not want to go to the Centers because they fear they will see some of their students there, and the students know much more about computers than they do! Teachers displaying their ignorance of computers may become embarrassed.*

We believe that Mexico, like China, should provide incentives to the teachers to become proficient in use of computers for education. We understand that in Mexico teachers' pay scales are linked to "points" that they acquire in continuing education. Why not give "points" for teachers who become certified in various on-line courses relevant to education? This idea is currently in test phase in Mexico. Having a technology-equipped Learning Center in a school with no linkage to the school's educational program is a tragically wasted opportunity.

Learning Centers as Cyber Cafés?

In Mexico and in China, cyber cafés look similar. They are simple rooms equipped with computers on desks. There may be refreshments and other amenities available. Since computers are not often present in homes in either country, cyber cafés offer the opportunity for local residents to learn about computers and to use them for e-mailing and other standard functions.

Visually, the CLCs in Mexico and China appear very similar to cyber cafés. Many of the Mexican Centers are used as free cyber cafés. That is not all bad, as such usage may be a first step in familiarizing people with the computer. But it is disappointing when one has so much excellent educational material that these materials are not more widely used. In some Mexican Centers, attentive facilitators have placed signs on the wall saying that the Center is NOT to be used as a cyber café. In China, where access to the CLCs is more restricted and not all centers are connected to the Internet, we are not aware that "cyber café usage" is yet a problem.

One attractive aspect of a cyber café is that it serves as a center for social activity, and this aspect could be expanded for the CLCs. Elsewhere in the world, public computer Centers have broadened their community appeal with desktop publishing, community newspapers, sales or rental of audio and video recordings, book lending, training, photocopying, faxing, and telephone services. It is up to a motivated facilitator to gauge what will make the Center an integral part of community life. She or he should be encouraged to be innovative and creative and should be given the tools to implement their plans. This is relevant in Mexico now and may become relevant in China in the future, as the university-managed CLCs become more open to the walk-in public.

In our visits, most walls of CLCs are wasted, barren and bare, except for a few signs displaying information or directives. They resemble the stark walls of many government bureaucratic offices, namely devoid of human interest. Why not use walls of the Centers as *valuable real estate*? Should the walls of Learning Centers display posters of current best students, awards, best Centers, etc.? Create *excitement* for the program and "branding" by using the walls.

Use of Appropriate Technologies and Pedagogies

If one thinks about the residents of underserved communities, the radio is one technology that almost all have. Many own or have access to televisions. These are "comfortable technologies," in use in day-to-day lives for decades. Yet, the university-supported learning Centers in Mexico and China emphasize the computer, a device new and foreign to many. As stated in a report given to us in Ningxia, regarding the Tsinghua University supported program, *"The fever of pursuing advanced equipment is not necessary. The fundamentals are more important. Schools should master the inexpensive equipment such as projector and CD player first"* (Department of Education of Yuanzhou District, 2004). While this particular quote relates to students learning via

technologies in schools, it also applies to adults in CDCs.

Transitions to higher-level technologies must be done with care. There is the popular Chinese proverb, "*A journey of a thousand miles begins with a single step*" (Lao-tzu). We believe that for adults entering the Centers for the first time, a transitional technology such as the familiar television or radio may be appropriate to bridge the gap between current technology awareness and comfort with the computer. For instance, many of the Centers in both China and Mexico have televisions. These could be used for short educational programs delivered by videotape, mentored and described live by the certified facilitator. China does implement this practice whereas, to the best of our knowledge, Mexico has not done so. In either country, the videotaped programs could introduce the new learners to the basics of computers, thereby reducing the perceived threat of the new technology. Or, they may contain locally useful educational content, such as information related to agriculture, parenting or artisan businesses. In the latter instance, the videotaped programs could also show how the Internet-linked computer can further help the learners by connecting to databases, threaded discussion groups and e-tailing businesses.

The format and layout of educational web pages should de-emphasize text and create more visuals and interactive components. There is a need to be user-friendly to those not familiar with the web and to those who might be turned away by text only. Adding more interactivity and media components becomes difficult when bandwidth is problematic. This might be an example in which media and interactive content is stored locally on a CD or local server, leaving Internet interactivity to text-oriented communication.

One pedagogical model that has been widely used in distance learning should be drastically reduced in practice. That is one in which a professor sits by a desk in a television-equipped classroom and in monotone voice reads before a television camera the text written on unimaginative text-only PowerPoint slides. When finished with one slide, he clicks the computer and goes to the next slide, where he continues an uninspired monotone recital of PowerPoint text. That is far from an optimal learning environment!

Business Incubators

A driver of demand for e-learning is the learner's perception of better living standards derived from increased educational attainment. The current systems of CLCs in both China and Mexico could do more actively to offer new employment opportunities for successful learners. The current literature is filled with success stories relating how residents of rural poor regions in the world have increased their standards of living by launching new entrepreneurial ventures using the Internet and related technologies. We suggest that in both China and Mexico CLCs be configured to support such bold entrepreneurial steps by citizens.

Here is one possible sequence: (1) a dedicated learner takes an entry level Basic Computer usage course; (2) she then takes an enhanced Entrepreneurship course that includes e-Entrepreneurship and writing of simple business plans. She becomes certified in both, by taking and passing comprehensive examinations in both. Then, (3) upon submission of an acceptable business plan to the government or private sector enablers (e.g., banks), she is offered a micro loan (of several hundred dollars) to start a new business. The micro loan could be provided by the federal government, or by a world body supporting such activities (e.g., the World Bank), or by foundations. If the new venture is to be an e-business, then the learner-turned-entrepreneur uses the CLC as a 1-year business incubator. That means that she can use one computer in the Center for selected periods of time to conduct her e-business. The business must move out by end of the first year. The business could be as simple as selling products on E-Bay. Examples: hand-made Mexican or Chinese crafts, candies, and certain agricultural products. The new entrepreneur may not be in business by herself but may represent a regional collective or collaborative association of several individuals, all selling their products via the e-business. The sales prices could be less than retail but much higher than the deeply discounted wholesale prices usually received by the originator of goods, especially when there are one or more "middlemen" involved in the usual supply chain.

Become a Self-Learning Organization, using Natural Experiments

The approximately 1250 operating CLCs in China and Mexico constitute, in their diversity, 1250 "naturally occurring experiments." The lead university in each country can use this diversity to learn best practices and worst practices. Take the "top N" and "bottom N" and analyze what factors make them that way. In Mexico N might be equal to 50; in

China, 20. This would enable others to learn from each extreme—to improve maximally by emulating best practices and to avoid mistakes of others. One could give periodic awards to local facilitators and students demonstrating best practices. And one could offer remedial educational services to those suffering worst practices. University students doing research, from Tsinghua and from Monterrey Tec, could select these topics for their Masters and even doctoral theses. These students could also do community level research that is vital to making the Learning Centers demand-driven.

CONCLUDING REMARKS

It was an honor to visit the ambitious poverty reduction/social development programs of China and Mexico. We were struck by how much the two programs have in common—both employing ICT technology to bring quality educational content to poor rural areas with the objective of social and economic development. We were impressed by the fact that a premier university of each respective country had initiated each of these educational programs. After returning from our visits, we decided to write this paper for two reasons. First, since the two countries' initiatives are similar in so many important respects, we felt that a unified paper would enable the planners of those programs to learn from each other. Second, it is our belief that these two young initiatives can serve as models for successful poverty alleviation programs in other developing countries. We feel strongly that the universities of developing countries must play significant roles in the process of increasing social and economic opportunities for poor, rural populations through the provision of equal access to quality education. Tsinghua University and Monterrey Tec are leaders in demonstrating the potentially powerful role that ICT's can play in guiding poor, isolated communities towards economic development and social inclusion.

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